CLAIMS

Sub A4

1. A method of generating a robust model of a system comprising:

selecting a modeling function having a set of weights wherein the modeling function has a complexity that is determined by a complexity parameter;

for each of a plurality of values of the complexity parameter, determining an associated set of weights of the modeling function such that a training error is minimized for a training data set;

determining an error for a cross validation data set for each set of weights associated with one of the plurality of values of the complexity parameter; and

selecting the set of weights associated with the value of the complexity parameter that best satisfies a cross validation criteria;

whereby the selected set of weights used with the modeling function provides the robust model.

2. A method of generating a robust model of a system as recited in claim 1 wherein the training error is calculated using a training error criteria that is a function of the difference between training output values associated with training input values determined from the training data set and output values determined from the modeling function and the associated set of weights applied to the training input values.

3. A method of generating a robust model of a system as recited in claim 1 wherein the complexity parameter affects the minimization of the training error.

4. A method of generating a robust model of a system as recited in claim 3 wherein the complexity parameter causes the training error to be decreased for sets of weights that are more complex.

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5. A method of generating a robust model of a system as recited in claim 4 wherein the complexity of a set of weights is determined by the squares of the weights.

6. A method of generating a robust model of a system as recited in claim 1 wherein the complexity parameter is a regularization factor.

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7. A method of generating a robust model of a system as recited in claim 1 wherein the complexity parameter controls an amount of noise that is added to the input data of the training set.

8. A method of generating a robust model of a system as recited in claim 1 wherein the modeling function is a first order polynomial.

9. A method of generating a robust model of a system as recited in claim 1 wherein the modeling function is a second order polynomial.

10. A method of generating a robust model of a system as recited in claim 1 wherein the modeling function is a second order polynomial that includes cross products between input values.

11. A method of generating a robust model of a system as recited in claim 1 wherein the plurality of values of the complexity parameter are selected to best satisfy the cross validation criteria using a Newtonian minimization scheme.

Sub a7

12. A method of generating a robust model of a system as recited in claim 1 wherein the plurality of values of the complexity parameter are selected to best satisfy the cross validation criteria using the Brent method.

13. A method of generating a robust model of a system as recited in claim 1 further including separating an empirical data set into a training data set and a cross-validation data set.

Sub a8

14. A method of generating a robust model of a system as recited in claim 1 wherein a threshold is applied to an output of the robust model to classify a set of inputs that generated the output.

15. A method of generating a robust model of a system as recited in claim 1 wherein the training error is defined as the sum of the squares of the differences between output elements of the training data and outputs of the modeling function associated with each of the input elements in the training data.

16. A method of generating a robust model of a system as recited in claim 1 wherein the training error is defined as the sum of the differences between output elements of the training data and outputs of the modeling function associated with each of the input elements in the training data.

A8 Cnt'd.

17. A method of generating a robust model of a system as recited in claim 1 wherein the training error is defined as the maximum difference between output elements of the training data and outputs of the modeling function associated with each of the input elements in the training data.

18. A method of generating a robust model of a system as recited in claim 1 further including normalizing the training data.

19. A method of generating a robust model of a system as recited in claim 1 further including splitting a set of data into a training data set and a cross validation training set.

20. A method of generating a robust model of a system as recited in claim 1 further including recalculating the set of weights using both the training data set and the cross validation data set.

21. A method of generating a robust model of a system as recited in claim 1 wherein the cross validation criteria is maximizing lift.

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22. A method of generating a robust model of a system as recited in claim 1 wherein the cross validation criteria is minimizing a measure of error between the model and the cross validation set.

23. A method of generating a robust model of a system comprising:

selecting a modeling function having a set of weights wherein the modeling function has a complexity that is determined by a complexity parameter;

for a each of a plurality of values of the complexity parameter, determining an associated set of weights of the modeling function such that a training error is minimized for a training data set;

determining a cross validation error for a cross validation data set for each set of weights associated with one of the plurality of values of the complexity parameter;

determining an optimal value of the complexity parameter that minimizes the cross validation error; and

determining an output set of weights of the modeling function using the determined optimal value of the complexity parameter and an aggregate training data set that includes the training data set and the cross validation data set such that an aggregate training error is minimized for the aggregate training data set; and

whereby the output set of weights used with the modeling function provides the robust model.

24. A robust modeling engine comprising:

a memory configured to store a training data set and a cross validation data set;

a processor configured to:

select a modeling function having a set of weights wherein the modeling function has a complexity that is determined by a complexity parameter;

for each of a plurality of values of the complexity parameter, determine an associated set of weights of the modeling function such that a training error is minimized for a training data set;

determine an error for a cross validation data set for each set of weights associated with one of the plurality of values of the complexity parameter; and

select the set of weights associated with the value of the complexity parameter that best satisfies a cross validation criteria; and

an output configured to output the set of weights associated with the value of the complexity parameter that best satisfies a cross validation criteria.

C9 Contd.